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The use of copolymers of carboxylic acids and long-chain compounds with isolated C-C multiple bonds as thickeners or dispersants

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The present invention relates to the use of copolymers of carboxylic acids and long-chain compounds with isolated C-C multiple bonds, with or without other copolymerizable monomers and cross-linkers, as thickeners or dispersants, eg. in cosmetic or
10 pharmaceutical preparations, and to cosmetic or pharmaceutical preparations containing these copolymers. Since some of the copolymers are novel substances, the invention also relates to these novel copolymers.

15 Conventional thickeners or viscosity regulators are copolymers of olefinically unsaturated carboxylic acids such as (meth)acrylic acid, maleic acid or maleic anhydride and hydrophobic comonomers such as (meth)acrylic esters, α -olefins with 2 - 12 carbon atoms or vinyl ethers such as vinyl methyl ether, with or without small
20 amounts of a crosslinker. Copolymers of these types are described, for example, in EP-A 328 725 (1) and EP-A 435 066 (2).

US-A 3 755 272 (3) discloses copolymers of unbranched α -olefins with 8 - 30 carbon atoms and (meth)acrylic acid. These copolymers
25 are suitable for producing electrodeposition paints, water-soluble surface coatings, floor coverings and textile-treating compositions.

EP-A 047 009 (4) relates to copolymers of 70 - 93% by weight of
30 partly or completely neutralized acrylic acid and 7 - 30% by weight of an α -olefin with 6 - 18 carbon atoms, with or without small amounts of a crosslinker. These copolymers are used as water-absorbing material in the form of, for example, films, fibers or fabrics in the medical and body care sectors. The co-
35 polymer is also recommended as flocculant in water treatment.

EP-A 0 335 624 discloses surface-active polymers suitable as thickeners which are composed of from 0.5 to 50% by weight of ionic, non-ionic or ampholytic α, β -unsaturated monomers having at
40 least one aliphatic or araliphatic lipophilic group of 8 to 30 carbon atoms, and of from 40 to 99% by weight of further non-lipophilic α, β -unsaturated monomers. The lipophilic monomers are predominantly ionic monomers, but also non-ionic (meth)acrylates or allyl ether compounds.

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The thickeners or viscosity regulators disclosed in the prior art have a number of disadvantages. Thus, these compositions are often insufficiently stable to hydrolysis and tend to decompose under the conditions of use. Some of these compositions have a not inconsiderable potential toxicity, which is particularly important for cosmetic use. Moreover the stability of the cosmetic preparations produced with these compositions, in particular of emulsions, is still not optimal, the stability to electrolytes in particular requiring improvement.

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It is an object of the present invention to provide novel thickeners and dispersants for cosmetic preparations which no longer have the prior art disadvantages described.

15 We have found that this object is achieved by using copolymers which are obtainable by free-radical polymerization of

- A) 50 - 99.9% by weight of an olefinically unsaturated C_3 - C_5 -monocarboxylic acid, of an olefinically unsaturated C_4 - C_8 -dicarboxylic acid or of its anhydride or a mixture of such carboxylic acids or anhydrides with
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- B) 0.1 - 50% by weight of one or more long-chain compounds with isolated C-C multiple bonds from the group comprising
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- (1) mono- or polyunsaturated C_8 - C_{30} -monocarboxylic acids which may have additional hydroxyl groups, as well as their alkali metal and alkaline earth metal salts, alkyl esters, amides, sorbitan esters, glycerol esters or polyglycerol esters,
- 30
- (2) mono- or polyunsaturated aliphatic C_8 - C_{30} -amines,
- (3) mono- or polyunsaturated C_8 - C_{30} -alcohols as well as their esters with saturated C_1 - C_4 -monocarboxylic acids,
- 35
- (4) C_8 - C_{30} -alkyl vinyl ethers which may contain up to 25 alkylene oxide units incorporated, and
- (5) terminal and internal C_{16} - C_{30} -alkenes,
- 40
- C) 0 - 49.9% by weight of other copolymerizable monomers and
- D) 0 - 10% by weight of one or more compounds with at least two olefinically unsaturated groups in the molecule as cross-linkers,
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as thickeners or dispersants.

In a preferred embodiment, the copolymer used according to the invention is composed of

- 5 A) 75 - 99.45% by weight, in particular 94 - 98.9% by weight, of the carboxylic acid component A,
- B) 0.5 - 24.95% by weight, in particular 1 - 5.9% by weight, of
10 the long-chain compounds with isolated C-C multiple bonds B,
- C) 0 - 24.45% by weight, in particular 0 - 4.9% by weight, of other copolymerizable monomers and
- 15 D) 0.05 - 5% by weight, in particular 0.1 - 2.5% by weight, of the crosslinker component D.

Particularly suitable as component A are acrylic acid, methacrylic acid or maleic anhydride, but also crotonic acid, 2-pentenoic
20 acid, maleic acid, fumaric acid or itaconic acid.

Long-chain compounds with isolated C-C multiple bonds B mean those with isolated acetylenic triple bonds and, in particular, those with isolated olefinic double bonds. "Isolated" means that
25 when a plurality of such C-C multiple bonds are present they are not conjugated and do not interact with functional groups with π electron systems, eg. carboxyl or carbonyl groups, either.

Particularly suitable long-chain carboxylic acids (1) for component B are naturally occurring unsaturated fatty acids, for example oleic acid, nervonic acid, α -hydroxynervonic acid, elaidic acid, erucic acid, stearolic acid, palmitoleic acid, vaccenic acid, linoleic acid, linolenic acid, petroselinic acid, arachidonic acid or ricinoleic acid. Of these, C₁₄-C₂₄-monocarboxylic
35 acids with 1 - 4 C-C multiple bonds, in particular olefinic double bonds, are preferred. The carboxylic acids (1) can be used in the form of the acid or as alkali metal salts, especially sodium or potassium salts, or as alkaline earth metal salts, in particular as calcium salts.

40 Esters of long-chain carboxylic acids (1) which are used are the C₁-C₄-alkyl esters such as the methyl, ethyl, n-propyl, n-butyl or tert-butyl esters, eg. methyl oleate, the esters of long-chain C₁₄-C₂₄-alcohols with 1 - 4 C-C multiple bonds, in particular olefinic double bonds, such as oleyl oleate, sorbitan esters such as
45 sorbitan monooleate or sesquioleate and the glycerol and polyglycerol esters, eg. mono-, di- and triglycerides such as glycer-

ol trioleate, that is to say including naturally occurring fats (lipids).

Also suitable are amides of the carboxylic acids described and
5 numerous amines, for example oleic acid diethanolamide, isoprop-
anolamide or dibutylamide.

Particularly suitable long-chain amines (2) for component B are
aliphatic primary C_{14} - C_{24} -amines with 1 - 4 C-C multiple bonds, in
10 particular olefinic double bonds, eg. oleylamine.

Long-chain alcohols (3) particularly used for component B are
primary C_{14} - C_{24} -alcohols with 1 - 4 C-C multiple bonds, in partic-
ular olefinic double bonds, as well as esters thereof with satur-
15 ated C_1 - C_4 -monocarboxylic acids such as formic acid, acetic acid,
propionic acid or butyric acid. Examples of (3) are oleyl alcohol
and oleyl acetate.

Likewise very suitable as component B are oils of natural origin,
20 in particular oils of vegetable origin, as well as natural waxes
and animal tallow, fats and greases which contain the said com-
pounds (1) to (3). Suitable examples thereof are coconut, palm
kernel, palm, peanut, soybean, rape, sunflower, igoba, olive,
sesame, cottonseed, linseed, safflower, corn, castor or fish oil.
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Examples of long-chain alkyl vinyl ethers (4) which may contain
up to 25, preferably up to 10, in particular up to 7, alkylene
oxide units, eg. ethylene oxide, propylene oxide or butylene ox-
ide units or mixtures thereof, incorporated are n-octyl vinyl
30 ether, 2-ethylhexyl vinyl ether, n-nonyl vinyl ether, isononyl
vinyl ether, n-decyl vinyl ether, n-dodecyl vinyl ether, n-tri-
decyl vinyl ether, isotridecyl vinyl ether, n-tetradecyl vinyl
ether, n-hexadecyl vinyl ether, n-octadecyl vinyl ether, n-eico-
syl vinyl ether or octadecyl heptaethyleneoxy-vinyl ether.
35 C_{10} - C_{25} -alkyl vinyl ethers are particularly preferred.

Particularly suitable long-chain terminal and internal alk-
enes (5) are terminal C_{16} - C_{24} -alkenes (α -olefins). Examples of (5)
are 1-hexadecene, 1-octadecene, 1-eicosene, 1-tetracosene as well
40 as C_{20}/C_{24} and C_{20}/C_{30} mixtures or cuts of the corresponding olefin
fractions.

Examples of other copolymerizable monomers C suitable for slight
modification of the copolymers used according to the invention
45 are n-vinylpyrrolidone, n-vinylcaprolactam, C_1 - C_{18} -alkyl
(meth)acrylates, eg. methyl (meth)acrylate, ethyl (meth)acrylate
or stearyl (meth)acrylate, (meth)acrylamide or N-(C_1 - C_{18} alk-

- yl) (meth)acrylamides, eg. N,N-dimethyl(meth)acrylamide, N-tert-butyl(meth)acrylamide or N-tert-octyl(meth)acrylamide, vinyl esters of C₁-C₁₈-carboxylic acids, eg. vinyl acetate, vinyl propionate, vinyl versatate, hydroxyalkylene mono(meth)acrylates with two to six carbon atoms in the alkylene chain or (meth)acrylates of polyethylene glycol monomethyl and monoethyl ethers with 1 - 25 ethylene oxide units in the molecule, eg. ethyl diglycol acrylate.
- 10 Used as crosslinker component D are olefinically polyunsaturated compounds such as, in particular, divinylbenzene, divinylethyleneurea, diallyltartaramide, methylenebisacrylamide, (meth)acrylates of polyfunctional alcohols such as trimethylolpropane, pentaerythritol, alkylene glycols with 2 - 6 carbon atoms in the
- 15 alkylene group, polyethylene glycols or polypropylene glycols, allyl esters of (meth)acrylic acid, oleyl (meth)acrylate, oleyl(meth)acrylamide, trivinylcyclohexane, triallyltriazine-trione and allyl ethers of trimethylolpropane, pentaerythritol and sucrose with at least two allyl ether units per molecule.
- 20 Pentaerythritol triallyl ether, pentaallylsucrose, allyl methacrylate, trimethylolpropane diallyl ether and methylenebisacrylamide are particularly preferred.

- The copolymers used according to the invention can be prepared in principle by polymerizing the monomers A to D by all conventional
- 25 methods. A particularly suitable method of preparation is precipitation polymerization in which the monomers, but not the polymer, are soluble in the solvent system used. Suitable solvents are aromatic compounds such as toluene or xylene, halogenated
- 30 compounds such as 1,1,1-trichloroethane or methylene chloride, as well as, in particular, semipolar solvents such as ketones with 3 - 6 carbon atoms and C₂-C₆-alkyl esters of formic and acetic acids, furthermore non-polar hydrocarbons, eg. cyclohexane or petroleum ether, as well as mixtures of these solvents. Also particularly
- 35 suitable are aromatic and aliphatic hydrocarbons with 5 - 12 carbon atoms in the molecule.

- The polymerization is carried out in the presence of a compound which forms free radicals, such as organic azo or peroxy compounds. Examples of suitable initiators are diacyl peroxides such
- 40 as dilauroyl, didecanoyl and dioctanoyl peroxides or peresters such as tert-butyl peroctanoate, tert-butyl perpivalate, tert-amyl perpivalate or tert-butyl perneodecanoate as well as azo compounds such as dimethyl 2,2'-azobis(isobutyrate), 2,2'-azobis(isobutyronitrile), 2,2'-azobis(2-methylbutyronitrile) or
- 45 2,2'-azobis(2,4-dimethylvaleronitrile).

It is possible to add a small amount of water, alcohols, protective colloids, emulsifiers or else relatively large amounts of a base, eg. potassium carbonate, to the polymerization mixture. The molecular weight of the polymers can, if desired, be reduced by
5 adding regulators to the polymerization mixture.

The polymerization process is preferably controlled so that the polymer results in the form of a fine-particle powder which is subjected, if required, to a suitable separation, drying or
10 grinding process.

The aim of the use according to the invention of the copolymers described is in particular to employ these substances as thickeners, gel formers and emulsifiers for industrial, pharmaceutical
15 and, in particular, cosmetic applications, for example in creams, lotions or gels. The described copolymers are very suitable for thickening aqueous systems to form thickened gels once the dispersed polymer has been sufficiently neutralized by adding a base such as triethanolamine, NaOH, KOH, 2-amino-2-methyl-1-propanol,
20 2-amino-2-methyl-1,3-propanediol, diisopropanolamine or tetrahydroxypropylethylenediamine. The polymers can be used in a similar way to prepare very stable emulsions from a water phase and an oil phase, in particular oil-in-water emulsions. Compared with conventional emulsifiers, in general smaller amounts of the polymer are required in order to obtain permanently stable emulsions.
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The present invention furthermore relates to cosmetic preparations which contain the copolymers used according to the invention as thickeners or dispersants in the amounts customary for
30 this purpose, ie. about 0.05 - 2% by weight.

Some of the copolymers used according to the invention are novel substances, and therefore the invention also relates to copolymers which are obtainable by free-radical polymerization of
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- A) 50 - 99.9% by weight of an olefinically unsaturated C₃-C₅-monocarboxylic acid, of an olefinically unsaturated C₄-C₈-dicarboxylic acid or of its anhydride or a mixture of such carboxylic acids or anhydrides with
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- B) 0.1 - 50% by weight of one or more long-chain compounds with isolated C-C multiple bonds from the group comprising
- (1) mono- or polyunsaturated C₈-C₃₀-monocarboxylic acids
45 which may have additional hydroxyl groups, as well as their alkali metal and alkaline earth metal salts, alkyl

esters, amides, sorbitan esters, glycerol esters or polyglycerol esters,

- 5 (2) mono- or polyunsaturated aliphatic C₈-C₃₀-amines,
- (3) mono- or polyunsaturated C₈-C₃₀-alcohols as well as their esters with saturated C₁-C₄-monocarboxylic acids, and
- 10 (4) C₈-C₃₀-alkyl vinyl ethers which may contain up to 25 alkylene oxide units incorporated,
- C) 0 - 49.9% by weight of other copolymerizable monomers and
- 15 D) 0 - 10% by weight of one or more compounds with at least two olefinically unsaturated groups in the molecule as crosslinkers.

The copolymers used according to the invention have a number of advantages. The chemical nature of the long-chain comonomers B
20 means that the hydrophobic portions of the polymer cannot be removed by hydrolysis; the particular thickening and dispersing action is therefore retained even under strongly hydrolytic conditions. The comonomers B moreover have a distinctly lower potential toxicity than, for example, the acrylate compounds disclosed in the prior art as comonomers.
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The synthesis of the copolymers used according to the invention takes place surprisingly well although, on the one hand, alkyl vinyl ethers are known to be prone to cationic autopolymerization
30 or hydrolysis in the presence of acidic compounds and, on the other hand, compounds with isolated olefinic double bonds, especially compounds with internal olefinic double bonds, are regarded as difficult to polymerize under free-radical conditions because under conventional conditions they can often be homopoly-
35 merized only inadequately or themselves are known to be regulating components in the polymerization of other monomers.

Examples

40 Unless otherwise indicated, percentage data are based on weight.

Example 1

1400 ml of 1,1,1-trichloroethane, 250 g of acrylic acid, 1.5 g of
45 pentaerythritol triallyl ether and 10 g of 1-octadecene were stirred and flushed with nitrogen for 30 min in a 3 l flanged flask. The mixture was heated to 80°C while stirring under a

stream of nitrogen and, after this temperature was reached, 100 ml of 1,1,1-trichloroethane and 0.4 g of dilauroyl peroxide were run in over the course of 3 h. After a further 3 h, the mixture was cooled, and the precipitated product was filtered
5 off, washed with 500 ml of 1,1,1-trichloroethane and dried at 60°C under reduced pressure.

To determine the gel viscosity, 1.0 g of the polymer was dispersed in 190 ml of water in a beaker. While stirring, 10 ml of a
10 10% strength triethanolamine solution were added. The viscosity of the resulting gel was determined with a manual viscometer (Haake VT-02) to be 8.0 Pa.s. It was evident when the gel was spread on a glass plate that it was smooth and virtually free of specks.

15 To check the emulsifiability, 0.4 g of the polymer was weighed into a beaker and dispersed in 30 ml of liquid paraffin. Then 100 ml of water and subsequently 4 ml of a 10% strength triethanolamine solution were added while stirring vigorously. The
20 emulsion was homogenized in a dispersing unit at 8000 rpm for a few s. The viscosity was determined as above to be 17.6 Pa.s. The structure of the emulsion was assessed after 1 h by spreading on a glass plate. The long-term stability was determined by introducing the emulsion into a 100 ml cylinder and evaluating
25 after 14 d. At this time the emulsion showed no tendency to separate.

Examples 2 to 19

30 Examples 2 to 19 were carried out in a similar way. Table 1 shows the results.

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Table 1

Composition and viscosities of the copolymers of Examples 2 to 19

Ex. No.	Comonomer B	Crosslinker D	Solvent [ratio by vol.]	Viscosity [Pa.s]	
				Gel	Emulsion
2	10 g 1-hexadecene a)	1.5 g PETA	cyclohexane	21.5	17.5
3	10 g 1-octadecene	1.5 g PETA	cyclohexane	22.0	19.5
4	10 g mixture of 60% 1-eicosene and 40% 1-tetracosene	1.5 g PETA	cyclohexane	23.0	19.0
5	10 g mixture of C ₂₄ -C ₃₀ -1-alkenes of the approximate composition C ₂₆ H ₅₂	1.5 g PETA	cyclohexane	24.6	19.5
6	10 g 1-octadecene	1.5 g PETA	isopropyl acetate	13.5	12.0
7	10 g 1-octadecene	1.5 g PETA	ethyl acetate/cyclo- hexane (1:1)	25.0	18.5
8	10 g 1-octadecene	1.5 g PETA	ethyl acetate/cyclo- hexane (1:3)	22.5	18.0

Ex. No.	Comonomer B	Crosslinker D	Solvent [ratio by vol.]	Viscosity [Pa.s]	
				Gel	Emulsion
9	10 g 1-octadecene	1.5 g PETA	methyl ethyl ketone/cyclohexane (1:1)	20.5	18.0
10	10 g 1-octadecene	1.5 g pentaallyl-sucrose	cyclohexane	21.0	19.0
11	10 g 1-octadecene	1.5 g allyl methacrylate	cyclohexane	12.0	11.5
12	10 g 1-octadecene	2.0 g PETA	cyclohexane	19.0	17.0
13	10 g 1-octadecene	1.0 g PETA	cyclohexane	17.5	14.0
14	10 g 1-octadecene	0.5 g PETA	cyclohexane	12.3	7.8
15	10 g 1-octadecene	0.2 g PETA	cyclohexane	5.2	3.7
16	40 g 1-octadecene	1.5 g PETA	cyclohexane	19.0	16.0
17	20 g 1-octadecene	1.5 g PETA	cyclohexane	20.0	16.0
18	5 g 1-octadecene	1.5 g PETA	cyclohexane	19.0	16.0
19	1.5 g 1-octadecene	1.5 g PETA	cyclohexane	18.5	14.1

250 g of acrylic acid were employed as component A in all of Examples 2 to 19.

PETA = Pentaerythritol triallyl ether

- a) Half the quantity of acrylic acid was added dropwise over the course of 2 h only after 80°C had been reached.

Example 20

1400 ml of 1,1,1-trichloroethane, 250 g of acrylic acid, 1.5 g of
5 pentaerythritol triallyl ether and 10 g of oleic acid were
stirred and flushed with nitrogen for 30 min in a 3 l flanged
flask. The mixture was heated to 80°C while stirring under a
stream of nitrogen and, after this temperature was reached,
100 ml of 1,1,1-trichloroethane and 0.4 g of dilauroyl peroxide
10 were run in over the course of 3 h. After a further 3 h, the
mixture was cooled, and the precipitated product was filtered
off, washed with 500 ml of 1,1,1-trichloroethane and dried at 60°C
under reduced pressure.

15 To determine the gel viscosity, 1.0 g of the polymer was dis-
persed in 190 ml of water in a beaker. While stirring, 10 ml of a
10% strength triethanolamine solution were added. The viscosity
of the resulting gel was determined with a manual viscometer
(Haake VT-02) to be 8.0 Pa.s. It was evident when the gel was
20 spread on a glass plate that it was smooth and virtually free of
specks.

To check the emulsifiability, 0.4 g of the polymer was weighed
into a beaker and dispersed in 30 ml of liquid paraffin. Then
25 100 ml of water and subsequently 4 ml of a 10% strength tri-
ethanolamine solution were added while stirring vigorously. The
emulsion was homogenized in a dispersing unit at 8000 rpm for a
few s. The viscosity was determined as above to be 7.6 Pa.s. The
structure of the emulsion was assessed after 1 h by spreading on
30 a glass plate. The long-term stability was determined by
introducing the emulsion into a 100 ml cylinder and evaluating
after 14 d. At this time the emulsion showed no tendency to
separate.

35 Examples 21 to 61

Examples 21 to 61 were carried out in a similar way. Table 2
shows the results.

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Table 2

Composition and viscosities of the copolymers of Examples 21 to 61

Ex. No.	Comonomer B	Crosslinker D	Solvent [ratio by vol.]	Reaction temp. [°C]	Viscosity [Pa.s]	
					Gel	Emulsion
21	20 g erucic acid	1.5 g PETA	1,1,1-tri-chloroethane	80	10.2	5.2
22	20 g oleic acid	1.5 g PETA	1,1,1-tri-chloroethane	80	9.1	6.9
23	20 g oleyl alcohol	1.5 g PETA	1,1,1-tri-chloroethane	80	6.5	3.8
24	20 g oleylamine	1.5 g PETA	1,1,1-tri-chloroethane	80	8.5	11.3
25	20 g methyl oleate	1.5 g PETA	1,1,1-tri-chloroethane	80	9.1	7.9
26	20 g oleyl acetate	1.5 g PETA	1,1,1-tri-chloroethane	80	8.6	8.7
27	20 g linoleic acid	1.5 g PETA	1,1,1-tri-chloroethane	80	4.3	2.5
28	14 g oleic acid	1.5 g PETA	cyclohexane	80	15.1	9.0
29	14 g olive oil	1.5 g PETA	cyclohexane	80	19.0	13.4

Ex. No.	Comonomer B	Crosslinker D	Solvent [ratio by vol.]	Reaction temp. [°C]	Viscosity [Pa.s]	
					Gel	Emulsion
30	14 g rape oil	1.5 g PETA	cyclohexane	80	12.6	7.4
31	14 g linseed oil	1.5 g PETA	cyclohexane	80	2.8	2.9
32	14 g sunflower oil	1.5 g PETA	cyclohexane	80	15.3	9.2
33	14 g soybean oil	1.5 g PETA	cyclohexane	80	12.7	6.7
34	14 g oleic acid	1.5 g PETA	ethyl acetate/ cyclohexane (1:3)	80	14.3	8.6
35	14 g oleic acid	1.5 g PETA	ethyl acetate/ cyclohexane (1:1)	80	12.9	8.4
36	14 g oleic acid	1.5 g PETA	ethyl acetate	80	11.8	7.9
37	14 g oleic acid	1.5 g PETA	isopropyl acetate	80	13.1	9.1
38	14 g oleic acid	1.5 g PETA	methyl ethyl ketone/cyclo- hexane (1:2)	80	11.2	6.2
39	14 g oleic acid	1.5 g PETA	n-hexane	80 (under 1.5 bar)	13.3	7.0

Ex. No.	Comonomer B	Crosslinker D	Solvent [ratio by vol.]	Reaction temp. [°C]	Gel	Viscosity [Pa.s] Emulsion
40	14 g oleic acid	1.5 g pentaallyl-sucrose	cyclohexane	80	13.2	8.1
41	14 g oleic acid	1.5 g allyl methacrylate	cyclohexane	80	9.0	6.7
42	14 g oleic acid	1.5 g trimethylol-propane diallyl ether	cyclohexane	80	10.1	4.9
43	14 g oleic acid	0.3 g methylenebis-acrylamide	cyclohexane	80	4.9	3.2
44	14 g oleic acid	1.8 g PETA	cyclohexane	80	10.8	6.7
45	14 g oleic acid	1.2 g PETA	cyclohexane	80	14.7	9.1
46	14 g oleic acid	0.9 g PETA	cyclohexane	80	11.1	7.2
47	14 g oleic acid	0.6 g PETA	cyclohexane	80	7.4	4.3
48	14 g oleic acid	0.3 g PETA	cyclohexane	80	5.2	3.6
49	14 g oleic acid	---	cyclohexane	80	2.2	2.9

Ex. No.	Comonomer B	Crosslinker D	Solvent [ratio by vol.]	Reaction temp. [°C]	Viscosity [Pa.s]	
					Gel	Emulsion
50	40 g oleic acid	1.5 g PETA	cyclohexane	80	12.5	8.3
51	10 g oleic acid	1.5 g PETA	cyclohexane	80	12.9	14.3
52	6 g oleic acid	1.5 g PETA	cyclohexane	80	11.7	9.2
53	14 g oleic acid	1.5 g PETA	cyclohexane	80	11.3	5.1
54	14 g oleic acid	1.5 g PETA	cyclohexane	80 a)	14.1	7.7
55	14 g oleic acid	1.5 g PETA	cyclohexane	80 b)	12.5	8.6
56	14 g oleic acid	1.5 g PETA	cyclohexane	80 c)	9.2	10.1
57	14 g oleic acid	1.5 g PETA	cyclohexane	60 d)	10.0	7.2
58	20 g oleyl alcohol	1.5 g PETA e)	1,1,1-tri-chloroethane	80	16.2	11.4
59	20 g oleyl alcohol 2 g TGO	1.5 g PETA	1,1,1-tri-chloroethane	80	19.1	10.5
60	20 g oleyl alcohol	1.5 g PETA f)	1,1,1-tri-chloroethane	80	11.9	4.9
61	20 g oleyl alcohol	1.5 g PETA g)	1,1,1-tri-chloroethane	80	11.7	6.3

250 g of acrylic acid were employed as component A in all of Examples 21 to 61.

PETA = Pentaerythritol triallyl ether,

TGO = Dioleyl ester of a polyglycerol ether with a degree of polymerization of 3

- a) 0.2 g dilauroyl peroxide as initiator
- b) 1.2 g dilauroyl peroxide as initiator
- c) 0.6 g dimethyl 2,2'-azobis(isobutyrate) as initiator
- d) 0.4 g tert-butyl perneodecanoate as initiator
- e) 2 g styrene/maleic anhydride copolymer (90:10/ M_w =2000) added
- f) 10 g potassium carbonate added
- g) 2 g water added

Example 62

1400 ml of 1,1,1-trichloroethane, 250 g of acrylic acid, 1.5 g of
5 pentaerythritol triallyl ether and 10 g of octadecyl vinyl ether
were stirred and flushed with nitrogen for 30 min in a 3 l
flanged flask. The mixture was heated to 80°C while stirring under
a stream of nitrogen and, after this temperature was reached,
100 ml of 1,1,1-trichloroethane and 0.4 g of dilauroyl peroxide
10 were run in over the course of 3 h. After a further 3 h, the
mixture was cooled, and the precipitated product was filtered
off, washed with 500 ml of 1,1,1-trichloroethane and dried at 60°C
under reduced pressure.

15 To determine the gel viscosity, 1.0 g of the polymer was dis-
persed in 190 ml of water in a beaker. While stirring, 10 ml of a
10% strength triethanolamine solution were added. The viscosity
of the resulting gel was determined with a manual viscometer
(Haake VT-02) to be 10.0 Pa.s. It was evident when the gel was
20 spread on a glass plate that it was smooth and virtually free of
specks.

To check the emulsifiability, 0.4 g of the polymer was weighed
into a beaker and dispersed in 30 ml of liquid paraffin. Then
25 100 ml of water and subsequently 4 ml of a 10% strength tri-
ethanolamine solution were added while stirring vigorously. The
emulsion was homogenized in a dispersing unit at 8000 rpm for a
few s. The viscosity was determined as above to be 8.0 Pa.s. The
structure of the emulsion was assessed after 1 h by spreading on
30 a glass plate. The long-term stability was determined by
introducing the emulsion into a 100 ml cylinder and evaluating
after 14 d. At this time the emulsion showed no tendency to
separate.

35 Examples 63 to 75

Examples 63 to 75 were carried out in a similar way. Table 3
shows the results.

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Table 3

Composition and viscosities of the copolymers of Examples 63 to 75

Ex. No.	Comonomer B	Crosslinker D	Solvent [ratio by vol.]	Viscosity [Pa.s]	
				Gel	Emulsion
63	10 g octadecyl vinyl ether	1.5 g PETA	cyclohexane	19.0	10.0
64	10 g dodecyl vinyl ether	1.5 g PETA	cyclohexane	15.0	10.0
65	10 g octadecyl heptaethylenoxy- vinyl ether	1.5 g PETA	cyclohexane	15.0	8.5
66	10 g octadecyl vinyl ether	1.5 g PETA	isopropyl acetate	13.0	11.0
67	10 g octadecyl vinyl ether	1.5 g PETA	ethyl acetate/ cyclohexane (1:1)	16.0	8.0
68	10 g octadecyl vinyl ether	1.5 g pentaallylsucrose	cyclohexane	21.0	13.0
69	10 g octadecyl vinyl ether	1.5 g allyl methacrylate	cyclohexane	12.0	9.5
70	10 g octadecyl vinyl ether	2.0 g PETA	cyclohexane	17.0	12.0
71	10 g octadecyl vinyl ether	1.0 g PETA	cyclohexane	16.5	14.0

Ex. No.	Comonomer B	Crosslinker D	Solvent [ratio by vol.]	Viscosity [Pa.s]	
				Gel	Emulsion
72	10 g octadecyl vinyl ether	0.5 g PETA	cyclohexane	12.5	7.0
73	20 g octadecyl vinyl ether	1.5 g PETA	cyclohexane	14.0	9.0
74	5 g octadecyl vinyl ether	1.5 g PETA	cyclohexane	28.0	16.0
75	1.5 g octadecyl vinyl ether	1.5 g PETA	cyclohexane	21.0	15.0

250 g of acrylic acid were employed as component A in all of Examples 63 to 75.

PETA = Pentaerythritol triallyl ether